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Bethesda, Maryland 20084

UNIVAC 494 TELETYPE EMULATION
USING A MICROCOMPUTER

by

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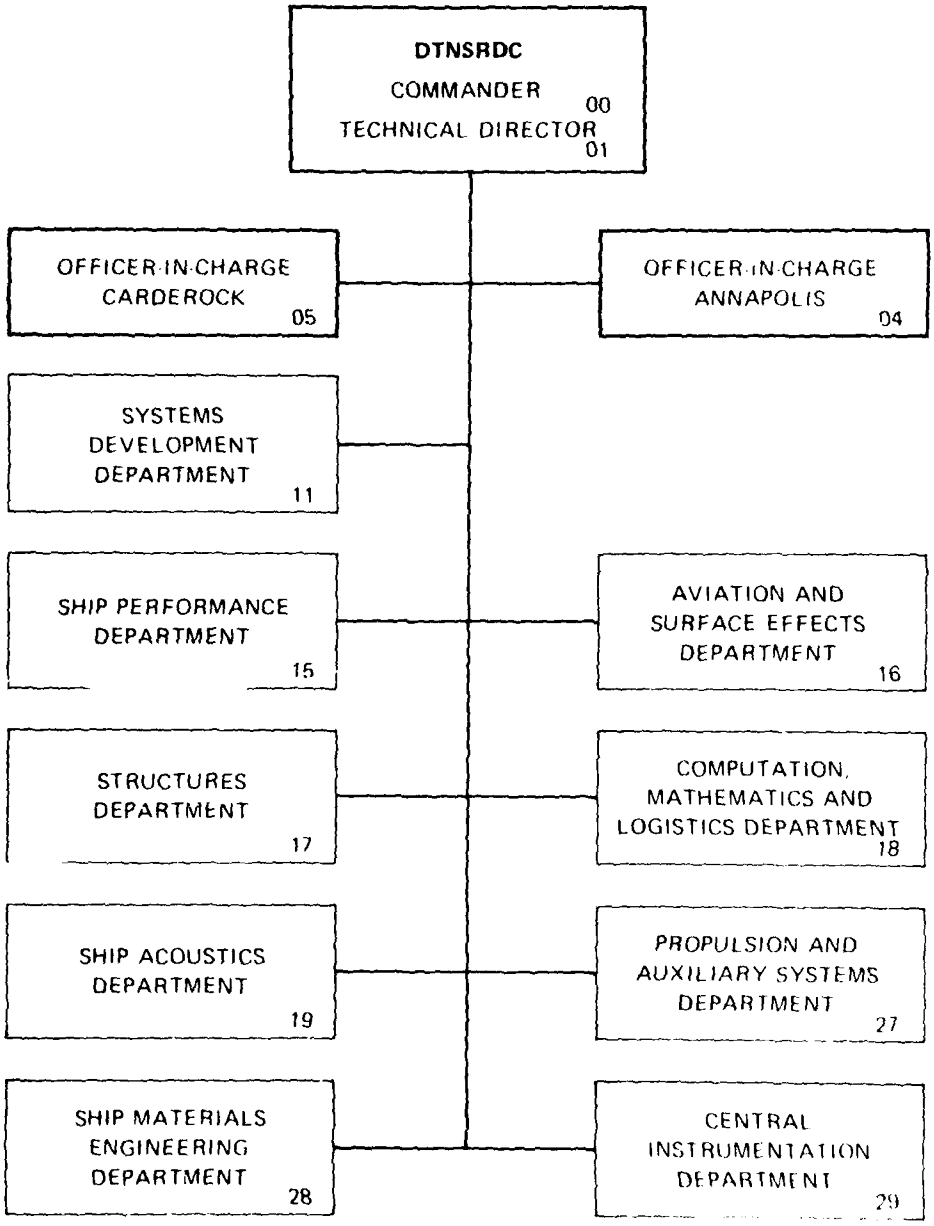

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This report provides information on the microcomputer-based model 33 teletype emulator software used to connect an experimental on-line stock levels recomputation system to a UNIVAC 494 mainframe computer located at the Navy Ships Parts Control Center, Mechanicsburg, Pennsylvania. The report includes an overview of emulator concepts, capabilities, usage, and organization.

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FOREWORD

This report provides information on the LSI 11 Model 33 teletype emulator program used to connect the experimental distributed processing levels recomputation system to the UNIVAC 494 computer located at the Navy Ships Parts Control Center, Mechanicsburg, Pennsylvania. Inquiries concerning the report should be directed to the Systems Development Technology Group, Computer Sciences and Information Systems Division, DTNSRDC.

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ABSTRACT

This report provides information on the microcomputer-based model 33 teletype emulator software used to connect the experimental distributed processing stock levels recomputation system to a UNIVAC 494 mainframe computer. The report includes an overview of emulator concepts, capabilities, usage, and organization.

ADMINISTRATIVE INFORMATION

The emulator software is a product of the Logistics Distributed Terminal Processing Project being carried out by the David W. Taylor Naval Ship R&D Center. The project is sponsored by the Naval Supply Systems Command as Work Unit 1-1828-012, Task Area TF 60531100, Task 62760N.

I. INTRODUCTION

Under sponsorship of the Naval Supply Systems Command, the Logistics Distributed Terminal Processing Project was established at the David W. Taylor Naval Ship Research and Development Center to investigate the potential for distributed processing within the Navy inventory control point (ICP) environment. One objective of the project is to identify inventory functions suitable for an intelligent terminal, and to develop an experimental terminal processing system capable of supporting some of the identified functions.

On the basis of responses to approximately 150 questionnaires circulated to ICP personnel, the levels recomputation function was selected for implementation on an advanced intelligent terminal system consisting of the following components: a microcomputer with hard disk storage; a display/ keyboard device; a printer; and a set of programs which enable an inventory specialist to access the ICP UNIVAC 494 (U494) master data file and to perform an on-line recomputation of stock levels.

This report discusses an important component of the experimental levels recomputation system, the emulator software which enables microcomputer programs to communicate with programs executing on the U494 using standard low-speed-terminal (i.e., teletype) data communications facilities.

II. OVERVIEW OF THE MICROCOMPUTER-BASED TELETYPE EMULATOR

A. TELETYPE EMULATION CONCEPT

The basic idea of the teletype emulation concept is that a microcomputer emulates the operations of a model 33 teletype device. The concept is implemented in environmental software that enables the levels recomputation system[1*] to communicate with the U494 computer using low-speed terminal communications support. Messages transmitted between the emulator software and the U494 programs are formatted in accordance with the data communications protocol used to ensure synchronization between the U494 and any connected model 33 teletype.

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*A complete list of references may be found on page 10.

B. U494 TELETYPE PROTOCOL

The U494 teletype protocol supported by the microcomputer emulator software consists of the following parameters:

1. U494 input buffer size of 20 characters.
2. Line speed of 300 baud (approximately 30 characters per second) using EIA RS232C format.
3. Parity always set.
4. Half-duplex mode with no line feed generated after a carriage return.
5. U494 prompt of three right braces generated as follows: one printed directly to the right of the user's input line; one printed in the first character position on each of two additional lines.
6. Control characters as follows:
   a. Inquiry response (ENQ) having an octal representation of 205. After sending an inquiry, the U494 waits for a response; if no response occurs within a specified time, a new inquiry is sent. The proper response to an inquiry is to fill the input buffer with FLUSH characters.
   b. North arrow (↑) response having an octal representation of 336. The north arrow causes a system message to be sent from the U494. The north arrow is self terminating and does not require an end of transmission signal (EOT); however, the use of a north arrow to terminate a message is improper.
   c. EOT having an octal representation of either 204 or 375. After sending a message, the U494 terminates the message with an octal 204. When sending a message to the U494, the proper response is to terminate the message with an octal 375 in the last position of the U494 input buffer.
   d. Flush response having an octal representation of 375. The response is used either as an EOT or as a means of signaling readiness for a U494 message (i.e., a response to ENQ), and must be in the last position of the U494 input buffer.

e. Fill signals (DELs) having an octal representation of 377. A FILL signal sent by the U494 can be ignored; sending a FILL signal to the U494 will cause characters in the U494 input buffer to be deleted.

7. System messages generated either when the U494 is idle or when it is responding to a north arrow. Possible messages, followed by a carriage return, a line feed, and an EOT, are as follows:

   a. Date and time in the format DDDDD/TTTTbbbb, where DDDDD is the Julian date, TTTT is the Navy time, and bbbb are four blank characters.

   b. System down message in the format NCSbbDOWN where bb are two blank characters.

   c. Administrative message beginning with either the designation ADMIN or the word FROM.

   d. Data in the form of a string of ASCII*-coded characters.

C. COMPUTER CONFIGURATION

Microcomputer hardware and system software components supporting teletype emulator development and operations are as follows:

. Hardware - The heart of the system is an LSI 11/2 microprocessor[2] manufactured by the Digital Equipment Corporation. The system also includes 64K bytes MOS memory, 5M bytes cartridge-disk storage (2.5M bytes removable), a Data Media DT80 keyboard/display,[3] a 7 x 9 Lear-Siegler dot matrix bidirectional printer[4] having a speed of at least 160 chars/sec., a bootstrap loader and extended arithmetic option, and a data communications interface in the form of a DLV11 serial line unit with an EIA driver for connection to an existing modem.

. Environmental Software - The emulator is supported by the RT-11 operating system,[5,6,7,8] which is a single-user system designed primarily for on-line operation, and by two language translators--a FORTRAN compiler and a MACRO assembler.

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*American Standard Code for Information Interchange.

D. EMULATOR CAPABILITIES AND USAGE

The LSI 11 teletype emulator is designed to operate in two modes: as a stand-alone computer program under control of an inventory specialist; and as a set of FORTRAN-callable subroutines that enable an executing microcomputer program to communicate with U494 real-time resources.

1. Stand-alone Mode

Using the emulator program TTYEM in stand-alone mode, the inventory specialist can transmit current model 33 teletype commands to the U494 for processing. After linkage with the U494 has been established, teletype command lines are keyed in between the emulator X (equivalent to the north arrow) and CTRL Z (equivalent to the HERE IS) delimiters. Output from the most recent X-CTRL Z command will be displayed on the DT80 screen and written to temporary storage; through use of the emulator P command, the output can be routed to the Lear-Siegler printer. The emulator V command allows a user to review output on the DT80 from the most recent X-CTRL Z transmit command. The commands DELETE, CTRL U, CTRLS, CTRL R, and CTRL I enable a user to modify a U494 teletype command before he issues the CTRL Z delimiter. A complete list of emulator commands and command explanations can be obtained by the H command.

2. Subroutine Mode

Three FORTRAN-callable subroutines, SRINIT, SDATA, and RDATA, enable the application programmer to control operation of the emulator from an executing program.

- Subroutine SRINIT - Enables the calling program to specify certain information regarding use of blank characters, carriage returns, and linefeeds.
- Subroutine SDATA - Enables the calling program to send data to the U494. The data must include the name of the real-time worker program to be executed and any pertinent input values if required.
- Subroutine RDATA - Enables the calling program to receive output data from a U494 real-time worker program.

Executable code for these subroutines is stored on two LSI 11 files (BLKDAT, DLLIB) that are designed to be linked with application sub-programs during microcomputer program development.

E. EMULATOR IMPLEMENTATION AND ARCHITECTURE

The current version of the program TTYEM has been implemented using [illegible] FORTRAN and 6 MACRO subprograms.

The architecture of TTYEM is summarized as follows:

TTYEM can be thought of as four sets of subprograms: an initializer set, a command builder, a command processor, and an output handler.

- Initializer - The function of the initializer is to set certain key variables to their appropriate values and to display the first emulator prompting signal > (a greater than sign) on the DT80 screen.
- Command Builder - The command builder set of subprograms is responsible for reading a user command from the DT80 keyboard; displaying the command on the DT80 screen; verifying that the command is valid in terms of its length and character coding; terminating the program's execution and dropping any connection with the U494 if a CTRL C character has been entered; and placing acceptable commands in a buffer area as required by the command processor.
- Command Processor - The command processor subprograms are responsible for carrying out emulator option commands identified as follows:

Command	Function
X-CTRL Z	Transmit a regular teletype command to the U494
P	Print the latest response to an X-CTRL command on the LSI-11 printer
V	Display the latest response to an X-CTRL command on the DT80 screen
OT	Change output device to DT80 display
OP	Change output device to printer
H	Generate a list of valid emulator commands
Q	Terminate emulator execution
HX	Explain use of the X (transmit) command
HP	Explain use of the P (print) command
HV	Explain use of the V (view) command
HO	Explain use of the O (output) command
HQ	Explain use of the Q (Quit) command

Upon receipt of a command in its buffer area, the command processor verifies that the command is syntactically correct, and if it is, executes the appropriate function. For example, with a valid X-CTRL Z command, the processor establishes a connection with the U494, formats the teletype command in accordance with the communications protocol, and transmits the command to the U494 for processing.

For a valid Q command, the processor disestablishes any connection with the U494 and terminates program execution, returning control to the RT-11 operating system.

After executing a command function, the processor displays the prompt ">" and gives control to the output handler for all commands except the Q command.

- Output Handler - Output handler subprograms are responsible for disposing of outputs generated by the U494 in response to teletype commands transmitted via the X-CTRL Z command. Upon receipt of a complete U494 output response, the handler routes the output to either the DT80 display or the Lear-Siegler printer (activated via the OP command) and maintains the output for subsequent review by either the P or V command. After completing its task, the handler gives control to the command builder.

The overall flow of control within the TTYEM program is shown in Figure 1. The current implementation of TTYEM requires approximately 30K bytes of main memory and 339 blocks of disk storage.

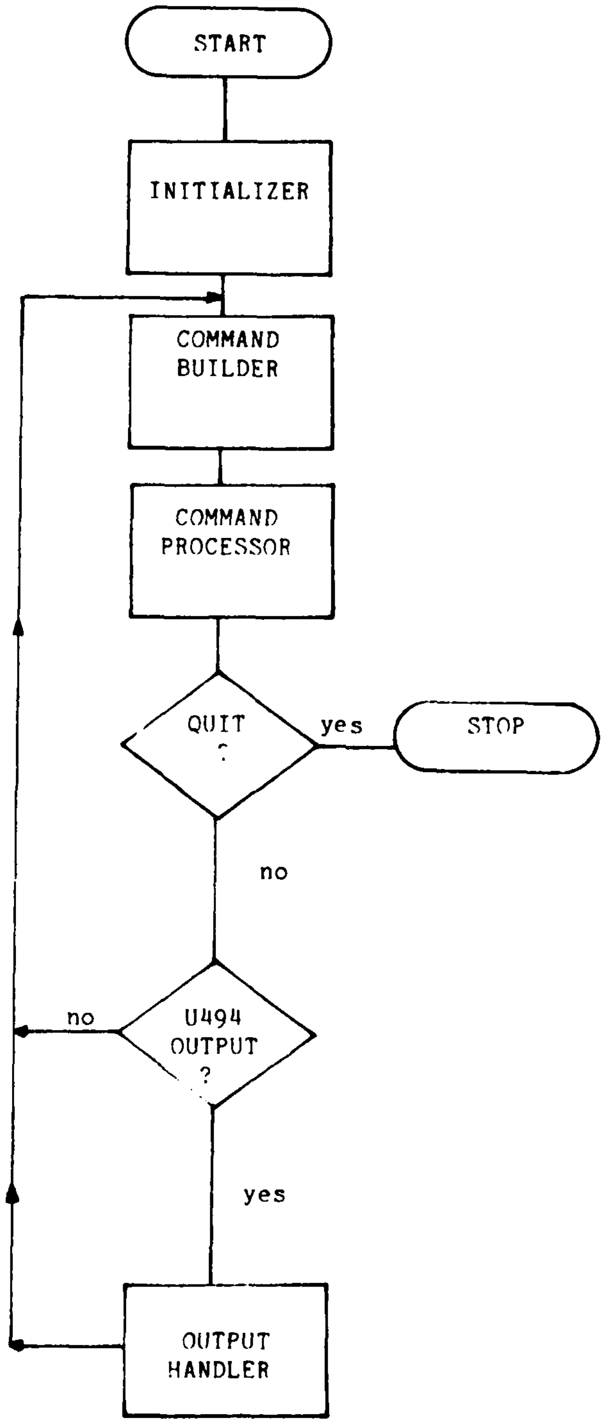

Figure 1 - Flow of Control Within TTYEM

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